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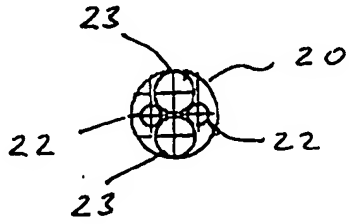
(54) Title: A PUNCHING APPARATUS

(57) Abstract

This invention relates to a punching apparatus (10) that may be used to punch samples (15) from a sheet of paper card (16). The location of potential samples on the paper card (16) is identified by identification means prior to engagement of the punch (11) thereby enabling the user to select those sites (22 and/or 23) on the paper card which possess optimum characteristics. The identification means includes illuminating means for illuminating on the paper card (16) both the location of the site and the peripheral boundary of the potential sample.



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A PUNCHING APPARATUS

This invention relates to a punching apparatus.

This invention has particular but not exclusive application to a punching apparatus adapted to punch selected portions or samples from a larger piece of paper card which is impregnated or in some way covered by a dried liquid product such as blood or urine, and for illustrative purposes reference will be made to such application. However, it is to be understood that this invention could be used in other applications, such as the preparation of articles punched from sheets of other materials including leather and metal.

Many medical tests are conducted using samples of blood or urine taken from patients. The samples may comprise dry blood or urine retained on a piece of paper card labelled with the patient's particulars or some other identification means. Preferably the blood or urine sample covers at least the area bounded by a test circle or a plurality of test circles marked on the card.

For testing purposes, portions of the card smeared or impregnated with blood material or urine are punched from the card using a punch and subsequently deposited in individual containers to which there is added selected reactants.

Apparatus which is adapted to punch up to four samples from a test circle on a paper card are known. The samples are generally circular in shape and are typically taken from the periphery of the test circle. As a consequence the "cross shaped" central portion of the test circle is either never used or, because of its odd shape, may not be able to be used.

Some apparatus have the ability to punch fewer samples but of larger size from each test card. However the operation of said apparatus is not continuous and

wherein the punching operation must be halted while punches are manually interchanged.

It is also noted that often the entire area of the test circle is not covered with blood material or urine. Because hitherto it has not been possible to identify accurately the site of the sample to be punched from the paper card prior to the commencement of the punching operation, instances of samples containing insufficient blood material or urine for testing purposes have been known to occur.

The present invention aims to alleviate at least one of the above disadvantages and to provide a punching apparatus which will be reliable and efficient in use. Other objects and advantages of this invention will hereinafter become apparent.

With the foregoing and other objects in view, this invention in one aspect resides broadly in a punching apparatus for punching an article from a sheet of material, said punching apparatus including:

support means for supporting the sheet of material to be punched;

a punch capable of operatively striking the sheet of material, and

identification means operatively associated with said punch, said identification means being adapted to provide a visual indication of the site on the sheet of material that shall be struck by said punch.

The configuration of the support means may allow movement of the sheet of material relative to the support means whereby, with the aid of the identification means, users may select sites on the sheet of material to be struck by the punch. Optimum sites in the case of a paper card impregnated with blood material or dried urine may be a region within a test circle which is covered entirely with said blood material or dried urine.

The support means may include holding means for holding the sheet of material on the support means in a preferred or selected position such as that which maximises the number of optimum sites. Furthermore, in some embodiments the holding means may be moveable relative to the punch whereby the site on the sheet of material that will be struck by said punch can be varied.

In one embodiment the identification means may be adapted to provide a visual indication of a single site. However, in other embodiments, the identification means may identify multiple sites on the sheet of material.

In one embodiment the identification means may provide a visual indication of the centre of the site that shall be struck by the punch. However, in other embodiments, the identification means may provide information which will enable users to identify the peripheral boundary of the site that shall be struck by the punch.

In one embodiment a visual indication of the site may be applied or projected directly onto the sheet of material. Alternatively, a visual indication of the location of the site may be provided by a cover covering the sheet of material. Preferably the cover is transparent and wherein said cover may lie on or be spaced above the sheet of material.

The identification means may also include a visual reference to the site. This may include marks applied to either the sheet of material or the cover, such as marks painted or sprayed thereon. Alternatively, the location of the site may be indicated by one or more perforations, indentations or such like in the sheet of material.

In still yet another embodiment, the identification means may include a scanner that shall scan the sheet of material and produce an image of the test area on which one or more sites are indicated. Furthermore, the location of the sites on

the image and hence the position of the punch when it strikes the sheet of material may be selectively varied.

However it is preferred that the identification means includes illuminating means which in use shall illuminate the location of the site on the sheet of material. For example the shape of the sample that will be produced by the punch, if the punch and sheet of material remain in their present positions, may be projected onto the sheet of material by a beam of light.

In some embodiments, instead of a single of punch, the apparatus may include a plurality of punches and wherein the punches may be arranged in sets. The apparatus may also be provided with selection means which will enable users to individually select punches or sets of punches they wish to use or which they desire to be operatively disabled.

The sheet of material in one embodiment may comprise a piece of paper card which has been impregnated, by way of example, with blood material or dried urine. However it will be appreciated that the sheet of material may be a sheet of metal.

The punch may be arranged such that it cuts a similarly shaped portion from the sheet of material. For example, the punching apparatus may also include a die having a bore adapted to receive an end portion of the punch or punch head and wherein the sample produced by the punch may pass through the bore to an awaiting receiving means.

The punching apparatus may also include injection means for injecting a fluid stream into said bore and wherein said fluid stream will assist in dislodging the sample should it adhere to either said bore or said punch head. The injection means may include a source of fluid, such as a reservoir or the like containing said fluid.

The fluid may include liquids that may subsequently be used in tests conducted in respect of the sample. However it is preferred that the fluid is dry filtered air.

The fluid may enter the bore via one or more apertures formed in a wall of the bore and/or an end portion of the punch head.

The fluid is preferably delivered to the bore by delivery means such as a pump in fluid communication with both the reservoir and the aperture(s).

The samples, having been cut from the sheet of material, may be deposited on to receiving means, such as a tray or a receptacle. Movement of the receiving means may be manually operated or automatically controlled by control means which may be operatively linked to the operation of the punch.

In order that this invention may be more easily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention; wherein:

FIG. 1 is a schematic cross-sectional view of a punching apparatus that is constructed in accordance with the present invention;

FIG. 2 is a plan view of a test circle on which is marked the site of four possible samples, and

FIG. 3 is a plan view of a test circle on which is marked the site of seven possible samples.

Figure 1 shows a punch apparatus 10 that includes a punch 11 capable of axial reciprocal movement. The punch 11 includes a cylindrically shaped punch head 12 that is locatable within a complementary shaped bore 13 of a die 14.

The punch 11 is used to cut circular shaped samples 15 from a sheet of paper card 16 that is supported by support means, not shown, located in between the punch head 12 and the die 14.

The bore includes a plurality of apertures 17 formed in the side wall 18. The apertures 17 are fluidly connected to a pump, not shown, that is used to draw dry filtered air from a reservoir, not shown.

Preferably the punching apparatus 10 is used to cut samples 15 from a test circle 20 printed on a piece of paper card 16. The samples may be impregnated with a variety of materials including blood material or dried urine.

The punching apparatus 10 also includes identification means that lights up the exact positions or sites on the paper card and within the test circle 20 from which disk shaped samples 15 are to be punched. In particular the size, shape and location of the potential samples are indicated by respective illuminated circles on the paper card 16. The identification means includes:

- a master pattern of seven adjacent sites 21, each of a standard diameter, and sub sets of those patterns, for use in situations where a laboratory requires a smaller number of samples;
- a second master pattern involving a combination of standard and larger spots 22 and 23 respectively, and sub sets of those patterns.

The identification means provides input information to a software program that controls the operation of the punch 11. Once a piece of paper card is placed on the support means, (and assuming a required pattern sub set has been preselected, based on the number and size of samples required), the operator then positions the card 16 under the light pattern so as to make best use of the material on the test circle 20 and engages the punch 11.

The paper card 16 is then automatically clamped into position. The combined identification means/punch 11 then moves in the direction of the die, so that the punch of the required size is located above the first site. The punch then engages

firstly the paper card 16 and then the bore thereby producing a disk shaped sample 15 that ordinarily would pass through the bore to the relevant well of a microtitre plate positioned below. However, should the sample 15 adhere to the side wall 18, the pulses of dry filtered air entering the bore 13 via apertures 17 will dislodge said sample 15 such that it may fall into the appropriate microtitre plate below.

Two stepper motors control the location of the punch, allowing such movement in an "x" and "y" direction that the punch can move to be above any point in the master punch pattern. This movement is preferably computer controlled, based upon input from the identification means.

The movement of the tray table holding the microtitre plates (located below the punch module/identification means) is preferably computer controlled and reflects the tray layouts required by the laboratory. However, in other embodiments, movement of the tray may be manually operated.

Once the first sample has been punched out, the punch positioning motors move the punch module so that the punch of the required size is above the second site. Because of the way that the punches are moved, and because the card is clamped, the sites targeted by the identification means can be immediately adjacent one another, i.e. with virtually no filter paper remaining between adjacent sites.

In the event that the amount of sample material in a particular spot on the card is insufficient to punch out the number of disc shaped samples required (based on the observation of the operator, after placing the paper card under the identification means) then the operator may, for any individual piece of card, choose, using a keyboard stroke, the number of discs to be punched from that spot on the card. After the punching of those discs, the card is then repositioned by the operator with a second part of the card, with additional sample material, under the identification

means. By default, the identification means will highlight that number of sites that represents the difference between the number required from that piece of card, and the number taken from the card before it was repositioned. The operator may, however, select a smaller number, if insufficient sample material is available at the second spot on the card.

It will of course be realised that the above has been given only by way of illustrative example of the present invention and that all such modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as is herein before defined in the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A punching apparatus for punching an article from a sheet of material, said punching apparatus including:

support means for supporting the sheet of material to be punched;

a punch capable of operatively striking the sheet of material, and

identification means operatively associated with said punch, said identification means being adapted to provide a visual indication of a site on the sheet of material that shall be struck by said punch.

2. A punching apparatus as claimed in claim 1, wherein said identification means includes illuminating means for illuminating the site on the sheet of material that shall be struck by said punch.

3. A punching apparatus as claimed in claim 2, wherein said identification means also shall identify a peripheral boundary of the sample that would be produced by said punch striking said site.

4. A punching apparatus as claimed in claim 2 or claim 3, wherein movement of the sheet of material, while illuminated by said identification means, relative to the punch is permitted thereby enabling a user to identify a site on the sheet of material having optimum characteristics.

5. A punching apparatus as claimed in any one of the preceding claims, wherein said support means includes holding means for holding the sheet of material in a preferred position with respect to said punch.

6. A punching apparatus as claimed in any one of the preceding claims, wherein said identification means is adapted to identify multiple potential sites on the sheet of material.

7. A punching apparatus as claimed in any one of the preceding claims, wherein said punching apparatus includes a plurality of punches and selection means which will enable users to individually select punches or sets of punches they wish to use or which they desire to be operatively disabled.

8. A punching apparatus as claimed in any one of the preceding claims, wherein there is also provided a bore adapted to receive said punch and injection means for injecting a fluid stream into said bore whereby said fluid stream may be used to dislodge the sample should it adhere to either said bore or said punch.

9. A punching apparatus as claimed in claim 8, wherein said fluid is dry filtered air.

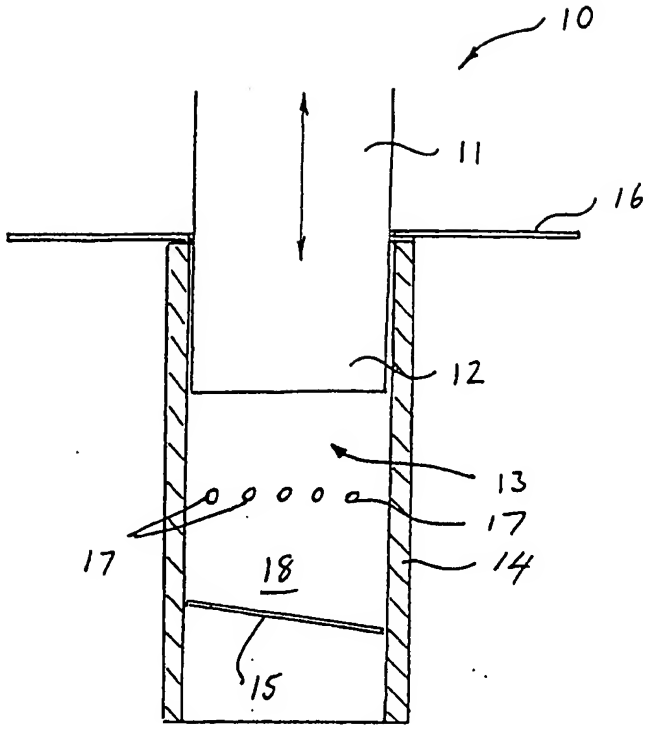

Fig. 1.

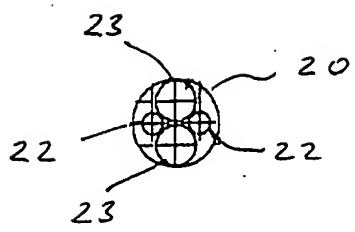

Fig 2.

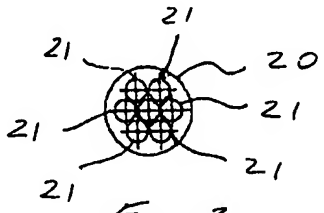

Fig 3.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00485

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: B21D 28/26, 28/34 B26F 1/02, 1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: B21D 28/26, 28/34 B26F 1/02, 1/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4893536 A (KINOSHITA) 16 January 1990 column 3 lines 1-43	1
X	US 4092892 A (MOONE) 6 June 1978 column 3 line 5 to column 4 line 13	1
X	Derwent Abstract Accession No. 98-475388/41 Class V04, JP 10202475 A (YAMAHA CORP) 4 August 1998 abstract and figure	1

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
23 September 1999	-7 OCT 1999
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 99/00485

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4893536	EP	311326	JP	1095831		
US	4092892	BR	7604077	DE	2627990	FR	2315366
		GB	1555461				

END OF ANNEX